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**United States Patent** [19][11] **Patent Number:** **5,453,944****Baumoe**[45] **Date of Patent:** **Sep. 26, 1995**

[54] **METHOD AND APPARATUS FOR LEAK DETECTION AND PIPELINE TEMPERATURE MODELLING METHOD AND APPARATUS**

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[52] **U.S. Cl.** ..... **364/578; 364/509**

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49.2, 49.1; 340/618, 605; 137/486

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[57] **ABSTRACT**

A method and apparatus of leak detection for a pipeline. The method includes dividing the pipeline into a plurality of segments, a first site station provided at the beginning of each segment and a second site station provided at the end of each segment, dividing each segment of the pipeline into a plurality of hypothetical pipeline sections, each section having the same nominal volume, measuring the liquid flow into the first section and determining a volume of liquid that has passed the first site station for a defined period, measuring the temperature of the liquid entering the first section at the first site station, measuring the liquid flow out of the last pipeline section of the segment and determining a volume of liquid that has passed the second site station for the defined period, measuring the temperature of the liquid leaving the last section at the second site station, measuring the temperature of the ambient to the pipeline at the first site station or that representative of the topography of the segment, measuring the temperature of the ambient to the pipeline at the second site station or that representative of the topography of the segment, computing the effect of the measured ambient temperatures at the first and second site stations on the sections intermediate the first and second site stations, computing the change in temperature of each section intermediate the first and second site stations due to conversion of kinetic energy into thermal energy and radiation and conduction of energy to or from the section, computing the change in volume of each section of pipeline wall and the change in volume of the liquid in each section based on the computed change in temperature of each section, determining the difference in measured volume between the volumes determined that have passed the first and second site stations for the defined period, correcting the difference in measured volume between the first and second site stations by adding or subtracting the change in the liquid and pipeline wall volume of all sections of the segment during the defined time period, comparing the corrected difference in measured volume between the first and second site stations with a threshold level, and generating an alarm signal if the difference exceeds the threshold level.

**74 Claims, 17 Drawing Sheets**